

SMART CCTV SYSTEM USING RASPBERRY PI

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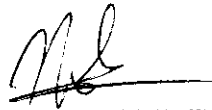
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This report is submitted in partial fulfilment of the requirements for the
Bachelor of Computer Science (Computer Networking)


FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
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2015

DECLARATION

I hereby declare that this project report entitled
SMART CCTV SYSTEM USING RASPBERRY PI

is written by me and is my own effort and that no part has been plagiarized without citations.

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DEDICATION

To my beloved parents

ACKNOWLEDGEMENT

Assalamualaikum, thanks to Allah because with His permission I can completed BITU 3973 subject Final Year Project in this final semester in UTeM that start on 23 February 2015 until 05 Jun 2015. Many thanks to Dr. Norharyati Bt Harum for her guidance and help for as long as I face difficulties and challenge in completing this project.

Apart from that, this subject teaches me meaning of patience and facing challenge with ease. I also can gain new experience with this subject. Furthermore, I wish to say deepest gratitude to my friends in give opinions and comments when I build the CCTV Smart System using Raspberry Pi.

Lastly, I want to thank to my beloved parents because raise me in excellent environment and give me an education until I reach this level.

ABSTRACT

This project is about the creation of Smart CCTV System using Raspberry Pi. The primary problem is that the common CCTV nowadays is expensive and do not has a smart system. They just monitoring the environment twenty-four hours and this will cause a used up a lot of memory space. The Smart CCTV System using Raspberry Pi will overcome this problem. This CCTV will have a motion detection system that will only capture a short video when a motion was detected. Then the video will be send to the user as an alert, so the user will know what happen to their properties. With the motion detection system this CCTV system can save up a lot of memory space because it only captured a short video when a motion was detected. Method that will be used and apply towards completing development of the system is actually one of the method that I had learnt before and it is one of the Rapid Application Development which is Waterfall Methodology. This methodology contains Planning, Analysis, Design, Implementation and Testing phases. It is excellent in providing system in a short schedule as the project must be done in about few weeks to complete the system.

ABSTRAK

Projek ini adalah tentang penghasilan Sistem *Smart CCTV* Sistem menggunakan Raspberry Pi. Masalah utama adalah bahawa CCTV yang biasa pada masa kini adalah mahal dan tidak mempunyai sistem pintar. Mereka hanya memantau keadaan sekeliling dalam masa dua puluh empat jam dan ini akan menyebabkan penggunaan banyak ruang ingatan. Sistem *Smart CCTV* menggunakan Raspberry Pi yang akan mengatasi masalah ini. CCTV ini akan mempunyai sistem pengesanan gerakan yang hanya akan menangkap video yang singkat apabila pergerakan dikesan. Kemudian video akan dihantar kepada pengguna sebagai amaran, sehingga pengguna akan tahu apa yang berlaku kepada kediaman mereka. Dengan sistem pengesanan gerakan CCTV ini boleh menyimpan sehingga banyak ruang ingatan kerana ia hanya merakam video yang singkat apabila pergerakan dikesan. Kaedah yang akan digunakan untuk melengkapkan pembangunan system sebenarnya salah satu kaedah yang pernah dipelajari saya sebelum ini dan ianya salah satu daripada *Rapid Application Development* iaitu *Waterfall* Metodologi. Metodologi ini mengandungi fasa Perancangan, Analisis, Rekacipta, Implikasi dan Percubaan. Ianya bagus didalam menyiapkan system dalam masa yang singkat sepertimana projek ini yang perlu disiapkan dalam masa beberapa minggu.

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LIST OF ABBREVIATIONS

CCTV	-	Closed-circuit television
USB	-	Universal Serial Bus
PIR	-	Passive Infrared

CHAPTER I

INTRODUCTION

1.1 Project Background

This project is about to make a smart closed-circuit television(CCTV) with a motion detector using a Raspberry Pi model B+ as a main component of this project. The goal of this project is to develop a low cost smart CCTV with a motion detector using a Raspberry Pi model B+. This project require Raspberry Pi, camera and a motion detection sensor to create a low cost smart CCTV with a motion detector.

Nowadays, common CCTV is a bit expensive and does not come in smart system such as using IG technology and motion detection system. Furthermore, common CCTV usually does not come with a real-time surveillance. This project is to make a low cost smart CCTV with a motion detection system. It also comes with a real-time surveillance that sends an alert when threat detected.

The Raspberry Pi is a credit-card sized mini-computer developed by the Raspberry Pi Foundation with the intention of promoting basic computer science in schools. Partly because of its very low cost the Raspberry Pi became immensely popular also outside of schools, where hobbyists have embraced the Raspberry Pi because of its many applications and cool projects [1].This project utilizes Raspberry Pi model B+ because it is more powerful than previous model, lower power usage, better audio and an extra USB ports than the older model. Thus, it can stream or watch Hi-definition video output at 1080P. CCTV system is a TV system in which signals are not publicly distributed but are monitored, primarily for surveillance and security purposes. CCTV relies on strategic placement of cameras, and observation of the camera's input on monitors somewhere. Because the cameras communicate with monitors and/or video recorders across private coaxial cable runs or wireless

communication links, they gain the designation "closed-circuit" to indicate that access to their content is limited by design only to those able to see it. [2]. Closed-circuit television monitoring system has now become an indispensable device in today's society. Supermarkets, factories, hospitals, hotels, schools, and companies are having their own CCTV system for 24/7 monitoring. It gives real-time monitoring, provides surveillance footage, and allows the authorities have evidences against illegal activities. It is believe that CCTV can deter crimes. Although surveillance camera records video and helps the authorities to identify the cause of an incident such as crime or accident, it is just a passive monitoring device [3]. The camera used in this project is Pi NoIR camera; it is a custom designed add-on for Raspberry Pi that does not have an infra-red filter with a 5 megapixel resolution and has a fixed focus lens on-board. A motion detector is a device that detects moving objects, particularly people. A motion detector is often integrated as a component of a system that automatically performs a task or alerts a user of motion in an area. A passive infrared sensor (PIR sensor) allows you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. [4].

1.2 Problem Statement

Table 1.1 shows the research problems are occurring. That also has been described in previous section.

Table 1.1: Summary of Problem Statements

PS	Problem Statement
1	Common CCTV nowadays is a bit expensive and thus certain people can't afford to buy it.
2	Current CCTV is not secure enough for unattended home or small office.

1.3 Project Question

Project Questions are found based on Problem Statements. Each project question is created to identify each problem statements as described in Table 1.2

Table 1.2: Summary of Project Questions

PQ	Project Question
1	How to build a low cost but useful CCTV?
2	How to implement CCTV that has a function to avoid crime?

1.4 Project Objective

Project Objective is found based on Problem Statements and Project Question. Each project objective is created as described in Table 1.3

Table 1.3: Summary of Project Objective

PQ	Project Objective
1	To study about the CCTV and Raspberry Pi.
2	To develop a low cost smart CCTV system using a Raspberry Pi with an alert system.
3	To verify the developed CCTV can perform as good as the common CCTV in the market with an extra alert function.

There are three project objectives that can be identified from this project which are listed as below:

PO 1: To study about the CCTV and Raspberry Pi.

The main purpose of this project is to study the Raspberry Pi function in developing a CCTV.

PO2: To develop a low cost smart CCTV system using a Raspberry Pi with an alert system.

This project will develop a low cost smart CCTV system using Raspberry Pi with motion detector system, that detect a moving thing that move under it radius.

PO3: To verify the developed CCTV can perform as good as the common CCTV in the market.

At the end of this project, the CCTV with an extra function developed must work as good as a common CCTV in the market. So that will make the developing a low cost smart CCTV is successful.

1.5 Scope

The scope of this research will focus on some issues as stated below:

1. This project is focused on usefulness of Raspberry Pi as a smart CCTV.
2. For this project we need to use a low cost equipment to achieve a goal that this project is cheaper than common CCTV.
3. This project is for small area surveillance such as small office or a home.
4. CCTV will be able to detect a motion and send an alert when a motion detected.

1.6 Project Significant

This project is about a developing a low cost smart CCTV using Raspberry Pi. The CCTV will develop based on Raspberry Pi as a main component, a PI NoIR camera and a PIR sensor. By using these components which is a low cost component, a CCTV will be developed. All the components will be placed in a box with a camera facing out of the box, with this the CCTV is invisible when the box was put under a strategic place where people can't see it. The CCTV will capture a short video when a motion was detected and then it will send an alert to the user, so the CCTV uses a real time monitoring.

1.7 Conclusion

This chapter helps to understand what the project background, scope of the project, objective that need to be achieve and problem occurred before started this project. This project will create a low cost smart CCTV with motion detection system using Raspberry Pi.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about literature review of this project which is Smart CCTV using Raspberry Pi. This chapter contains about related work, critical review, proposed solution and conclusion. In related work we discuss about keyword and previous research that has related to this project. In critical review we critically review the previous research. Then in proposed solution we discuss about this project, lastly discusses about conclusion which conclude all about this project.

2.2 Related work/previous work

2.2.1 Keywords

Raspberry Pi –

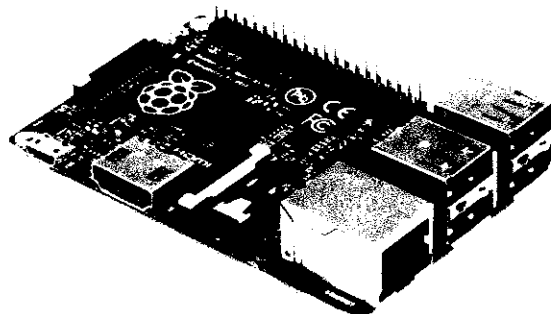


Figure 2.1: Raspberry Pi Model B+

In an era where everything is less expensive and smaller, the actual components in our gadgets are increasingly buried deep inside sealed glass, plastic, or aluminium cases. Back then, young people could find their way into programming purely through natural curiosity if they played with the technology they found in their homes. But with today's completely smooth, totally locked-up technical marvels, there's very little curiosity among the younger generation to learn more about what's going on "inside" [5]. Raspberry Pi is a low power, inexpensive microcomputer. Although, the Raspberry Pi is a small, inexpensive, low-power computer, it is, a very flexible machine especially in terms of programming, and its capabilities have made it as a cheap way of accessing a relatively large amount of computation power [6]. We have chosen this board for its easy and powerful HD camera handling, good performance to power consumption ratio affordable price and wide community. This is very good to our project [11].

PIR Sensor-

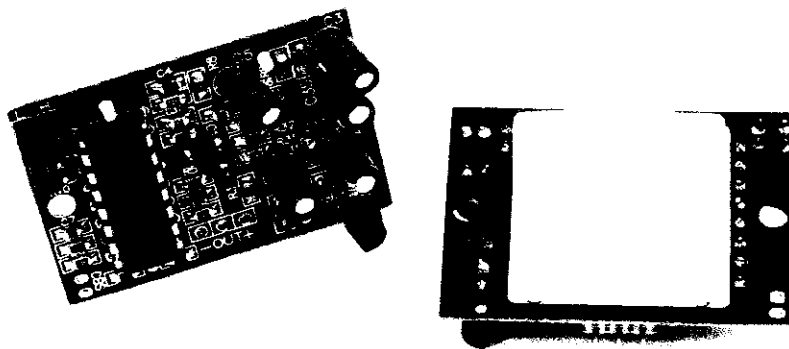


Figure 2.2: PIR Sensor

PIR sensor is used to detect object motion from about 20 feet away. It comes with adjustable delay to firing and sensitivity. Implementation of Optical Flow Motion Detection algorithm on Raspberry Pi works by comparing two successive image frames. To find out a displaced object, the algorithm tries to guess the direction of displaced object rather than scanning the second image for the matching pixel. This

can be done by solving for the optical flow vector by assuming that the vector will be similar to a small neighbourhood surrounding the pixel. The algorithm was simulated using Python OpenCV [10].

Pi Camera-

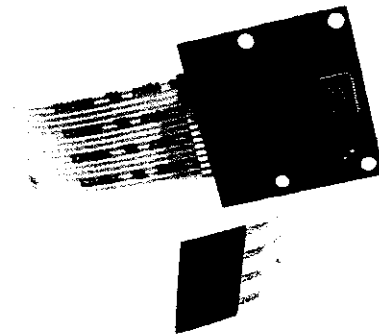


Figure 2.3: Pi Camera

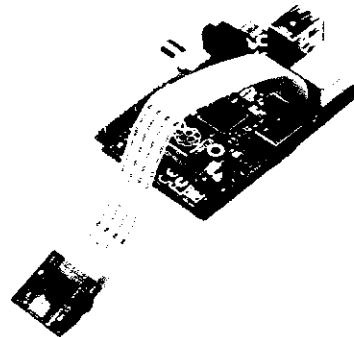


Figure 2.4: Pi Camera with Raspberry Pi

The Raspberry Pi No Infrared camera is designed for a Raspberry Pi and has no infra-red filter which makes it can record a night vision video. The camera board has a cable connect to it, to connect the camera to the Raspberry Pi the camera cable must be insert at a camera slot next to HDMI slot in the Raspberry Pi board. The camera is 5 megapixels resolution which is good for capturing a video.

2.2.2 Previous Work/Related Work

Based on the **Charles Severance (October 2013)** in his “Computing Conversations Column article wrote why and how Eben Upton formed the Raspberry Pi Foundation” [5]. The main purpose is to create a cheap computer yet small as small as credit card that has a function same like real computer but with less powerful and use low power to operate it. It is to show a young generation what inside the computer and attract them to programming language, to create any project within the power of this mini-computer. The Raspberry Pi Foundation is a non-profit foundation created by Eben Upton and his friends in 2009. There had designed a BCM 2835 into miniature single-board computer. The raspberry pi concepts are based on the series of Broadcom chips and they do all the software development process where decides on ARM-based Linux system for the raspberry pi platform and yet the BCM 2835 already had all the features such as support for HDMI, standard display, a video and 3D accelerator, a camera processor, digital signal processors and a USB controller. The problem is it needs to show how the Raspberry Pi technology can be developing as energy efficient and low cost technology. So with the developing a low cost smart CCTV that using a Raspberry Pi will show how the Raspberry Pi technology develop an energy efficient and low cost technology.

Wilson Feipeng Abaya, Jimmy Basa, Michael Sy, Alexander C. Abad and Elmer P. Dadios (November 2014) in their research paper “Low Cost Smart Security Camera with Night Vision Capability Using Raspberry Pi and OpenCV” [9] to provide security with low cost smart security camera with night vision capability using Raspberry and Open Source Computer Vision (OpenCV). The system was designed to be used inside a warehouse facility. It has human detection and smoke detection capability that can provide precaution to potential crimes and potential fire. The credit card size Raspberry Pi with OpenCV software handles the image processing, control algorithms for the alarms and sends captured pictures to user’s email via Wi-Fi. As part of its alarm system, it will play the recorded sounds:

“intruder” or “smoke detected” when there is a detection [9]. The problem is the time delay to processing the image is higher because it used a lot of function and the Raspberry Pi cannot process so many functions. The low cost smart CCTV does not use a lot of function because it is a simple but very effective system. It send an alert to the user when a motion detected and it does not played a sound as an alarm because it will cost a RAM space to perform the function.

Rinu Merin Baby and Rooha Razmid Ahamed (2014) in their research “Optical Flow Motion Detection on Raspberry Pi” [10] to show implementation of Optical Flow Motion Detection algorithm on Raspberry Pi with the Lucas-Kanade method. By using two successive image frames to find out a displaced object. The algorithm was simulated using Python OpenCV. The implementation of Lucas-Kanade algorithm was successfully done on Raspberry Pi. The problem is it used a real-time captured video which using a lot of memory space. The low cost smart CCTV just captured a short video when a motion was detected and this does not used a lot of memory space.

Michal Kochlan, Michal Hodon, Lukas Cechavic, Jan Kapitulik and Matus Jurecka (2014) in their research “WSN for Traffic Monitoring using Raspberry Pi Board” [11]. This paper introduces low-cost non-intrusive sensory that can collect traffic data based on Raspberry Pi single board computer. Image information acquired by Raspberry Pi HD camera module is analyzed for moving objects presence. After evaluation of detected object count, size, class and motion vector object properties are sent to server node by RF transceiver. Sensor low-power consumption ensures possibility to operate from battery for an extended period of time [11]. This project meant for a traffic monitoring, compared to the low cost smart CCTV that focused on home or small office security. The problem of the project is the speed of the movement object does not show up, it just detects a movement object and it is far from being a good traffic monitoring.